18(3), 18(7), 24(2)
AUTHOR: Aleksandrov, L. N. SOV/126-7-2-2/39

TITLE: Theoretical Analysis of the Influence of Carbon on the Kinetics of Isothermal Decomposition of Super-cooled Austenite (Teoreticheskiy analiz vliyaniya ugleroda na kinetiku izotermicheskogo raspada pereokhlazhdennogo austenita)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1959, Vol 7, Nr 2, pp 169-173 (USSR)

ABSTRACT: The analysis is based on the work of Aleksandrov and Lyubov (Ref 5) in which the dependence of the time t, taken for complete transformation, in a definite portion of the original volume η of austenite of hypo-eutectoid composition in carbon and alloy steels, on the concentration of carbon and alloy additions (in the temperature range T of the first step) is established. In the general case

$$t = \left\{ - \frac{15h \ln (1 - \eta)}{8\pi RTD_0^{3/2} \beta^3} \exp\left(\frac{W + U + \frac{3}{2} Q}{RT} \right) \right.^{2/5} -$$

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$$- \frac{5\pi^3 d^{12} (\Delta F_0)^3 \tau^4}{8 \cdot 3^6 h^3 D_0^{3/2} \beta^3} \exp\left(\frac{\frac{3}{2}Q - 3U}{RT}\right) + \tau^{5/2} \Bigg\}^{2/5} \quad (1)$$

where ΔF_0 is the change in free energy on formation of a unit volume of the new phase; U is the activation energy of the transformation of the lattice of the primary component of the solid solution (iron); d is the atomic diameter of the primary component; h is Planck's constant; W is the work expended in the formation of nuclei of the new phase having the critical dimension

$$W = \frac{1}{3}\sigma S_{kp} \; ; \quad S_{kp} = 4\pi\rho_{kp}^2$$

(σ is the surface tension in the boundary between the two phases, $\rho_{kp} = \frac{2\sigma}{\Delta F_0}$);

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β is the root of the transcendental equation (Ref. 5)

$$F(\beta) = \frac{c^{nar}_{rav} - c_o}{c^{nar}_{rav} - c_{n.f.}}$$

c_o and $c_{n.f.}$ is the concentration of carbon in the original austenite and in the new phase (ferrite);
c^{nar}_{rav} is the equilibrium concentration in the boundary between the austenite and the ferrite phases;
D_o and Q are diffusion constants (the diffusion coefficient of carbon in austenite $D = D_o \exp(-Q/RT)$, where R is the universal gas constant);
τ is the time taken for the growing centre of the new phase to reach some limiting dimension ρ_{gr}. It clarifies the nature of the mechanism determining the rate of growth - diffusion or transformation. The growth of the grains of the new phase at $\rho < \rho_{gr}$

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(corresponding to $t < \tau$) is also limited by the rate of lattice transformation, and at $\rho > \rho_{gr}$ (i.e. at $t > \tau$) it is limited by the rate at which carbon is rejected from the grains of the new phase (ferrite) in the austenite matrix. If τ is small as compared with the total time of transformation, then Eq (1) can be replaced by the expression

$$t = \left[- \frac{15h \ln (1 - \eta)}{8\pi RT\beta^3 D_o^{3/2}} \right]^{2/5} \exp\left(\frac{\frac{2}{5}(W+U) + \frac{3}{5}Q}{RT} \right). \quad (2)$$

If, however, τ is considerably greater than t, then the growing centres will not reach the value of ρ_{gr} and the time taken for transformation should be calculated according to:

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$$t = \frac{3h}{\pi d^3 \Delta F_o} \left[- \frac{27 \ln (1-\eta) \Delta F_o}{RT} \right]^{1/4} \exp \left(\frac{\frac{1}{4} W + U}{RT} \right) \quad (3)$$

The magnitude of τ has been calculated (Ref 4) by the formula

$$\tau = D_o \left(\frac{c^{nar}_{rav} - c_{n.f.}}{c_o - c_{n.f.}} \right)^2 \left(\frac{27 h}{2\pi d^4 \beta \Delta F_o} \right)^2 \exp \left(\frac{2U - Q}{RT} \right). \quad (4)$$

The results of calculation of τ lead to the conclusion that Eq (3) can be used in the analysis of decomposition of austenite for the majority of alloy steels as well as carbon steels at a transformation temperature below 650°C. Eq (1) should be used for carbon steels at the transformation temperature above 650°C and for low alloy steels at a transformation temperature above 700°C but it is also possible to use Eq (2). In Fig 1 the continuous curves 1 and 2 are characteristic of the transformation

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of 5% austenite in such steels according to data obtained by Kogan and Entin (Ref 9). The dashed curves 1' and 2' correspond to calculations according to formula (3) - 1' for a steel containing 0.05% C, 2' for a 0.4% carbon steel. In carbon steels the absolute decrease in the activation energy of transformation with increase in carbon content is small, but the growth of surface tension reaches a considerable absolute magnitude. If the kinetics can be described by Eq (2), then the retarding action of diffusion processes play a deciding role and the decomposition of austenite proceeds to completion. The influence of carbon on the kinetics of isothermal decomposition of super-cooled austenite in hyper-eutectoid steels can be analysed by a similar method. There are 1 figure and 9 references, 8 of which are Soviet, 1 English.

ASSOCIATION: Mariyskiy pedagogicheskiy Institut (Mari Pedagogic Institute)

SUBMITTED: June 18, 1957

SOV/126-8-2-10/26

AUTHORS: Aleksandrov, L.N. and Lyubov, B.Ya.

TITLE: Contribution on the Influence of Alloying on the Kinetics of the Pearlite Transformation

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 8, Nr 2, pp 216 - 224 (USSR)

ABSTRACT: Considerable differences of opinion exist (R.I. Entin et al - Refs 1-4) on the reasons for the influence of alloying elements on the kinetics of the pearlite transformation in austenite. This transformation, the authors point out, is important not only in eutectoidal but also in hyper- and hypo-eutectoidal steels since the excess ferrite (or cementite) liberated in the early stages of the transformation leads to the attainment of the eutectoidal state. To elucidate the influence of alloying elements the relation between the rate of formation of centres of the new phase, the lateral rate of growth of the pearlite grain, the alloying element concentration and the transformation temperature were studied. The authors use available information (Ya. S. Umanskiy et al - Refs 6-8) to discuss these relations.

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They consider the movement of the austenite/pearlite boundary, ignoring its curvature, obtaining an equation from which the rate of growth of a pearlite grain in the eutectoidal transformation of both unalloyed and alloyed steel; the equation, unlike previous ones (Refs 4,9) has no constants determined from rates found experimentally. As a first approximation, the authors assume that the change of activation energy for the $\gamma \rightarrow \alpha$ iron transformation on alloying corresponds to the change of that of the self-diffusion. From their equation the authors conclude that alloying can reduce the rate of rearrangement of the iron lattice to such an extent that it becomes rate-controlling. To calculate the rate of growth of pearlite grains depending on diffusion of carbon in alloyed austenite, the authors use their previous (Ref 12) results, allowing for the considerable influence

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of concentrating strains on diffusion. Calculated values of pearlite-transformation rate are close to or considerably higher than experimental for unalloyed or chromium steel, respectively. A form of the diffusion equation is solved by the authors in their previous manner (Ref 12) to give relations for pearlite-growth rate in the formation of ferrite-carbide mixture where this is limited by diffusional redistribution of the alloying element in austenite. They conclude that this could not be the rate-controlling factor for chromium, nickel, manganese and some other alloying elements with a high activation energy of diffusion, but could be for elements such as molybdenum. The authors then deduce kinetic equations for the pearlite transformation for control by iron-lattice rearrangement, by carbon diffusion and alloying element diffusion. They calculate kinetic curves for 50% transformation of austenite in unalloyed (Figure 1) and alloyed (0.4% C, 8.5% Cr) steel and consider a steel with 0.5% Cr and 0.4% C; then compare

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calculated and experimental results. With over 2.5% Cr, the pearlite transformation rate is governed by the polymorphic transformation. Their results show that the views of Frye, Stansbury, McElroy (Ref 9) that the rearrangement mechanism is rate controlling in eutectoidal unalloyed steel are incorrect. There are 2 figures and 18 references, of which 14 are Soviet and 4 English.

ASSOCIATION: Mordovskiy gosudarstvennyy universitet (Mordovskiy State University)
Institut metallovedeniya i fiziki metallov TsNIIChM (Institute of Metallurgy and Metal Physics of TsNIIChM)

SUBMITTED: June 14, 1958

S/148/60/000/006/005/010

AUTHOR: Aleksandrov, L. N.

TITLE: On Methods of Investigating Recrystallization

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Chernaya metallurgiya, 1960, No. 6, pp. 103-105

TEXT: Recrystallization kinetics is characterized by the activation energy of recrystallization (U) which can be approximately determined from the time of recrystallization beginning or from the time of attaining a certain state by the alloy studied at a given temperature. This method requires the calculation of tg α which is the inclination angle of the tangent to the curve of relationship between the logarithm of time and inverse temperature. The given method is founded and G. K. L'vov's equations (Ref. 2) are specified in this article. An equation describing the dependence between temperature, time and activation energy of recrystallization can be derived from the general theory of phase transformations or from the approximate Avrami theory of recrystallization. The equation derived from the general theory of phase transformations is based on the known expression for a certain fraction of the recrystallization volume described through the rate of recrystallization

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nucleation and the rate of grain growth for the case of their spherical shape. It appears however, that this method determines not U but U_{ef}, exceeding the true activation energy of recrystallization by 1/4 of the nucleation work. Data given in Reference 5 for recrystallization in carbon steel with 0.08% C, deformed to 8% (activation energy of grain growth U = 68 kcal/mole; activation energy of nucleation U + W = 76 kcal/mole) justify for a number of cases, the identification of U and U_{ef}. For this steel grade the difference between U and U_{ef} is 2 kcal/mole. An analysis of methods show that the use of Avrami's equation may yield different data on the activation energy of recrystallization. This may explain the difference of values obtained for the activation energy of recrystallization and grain growth in Reference 4 and 7. There are 7 references: 4 Soviet and 3 English. VC

ASSOCIATION: Moskovskiy gosudarstvennyy universitet (Moscow State University)

SUBMITTED: November 13, 1959.

APPROVED FOR RELEASE: 06/05/2000 CIA-RDP86-00513R000100820020-8"

S/148/60/000/008/016/018/XX
A161/A029

18.7500

AUTHOR: Aleksandrov, L.N.

TITLE: On the Theory of Perlite Growth

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. - Chernaya metallurgiya, 1960, No. 8, pp. 110 - 114

TEXT: The available data of 29 works (Refs. 1 - 29), including seven in which the author participated, are briefly reviewed and analyzed; omissions made by different authors in their investigations are pointed out. The author considers that the solution of the problem by B.Ya. Lyubov (Ref. 21) is nearer to the true mechanism of perlite growth than that obtained by J. Čadek (Ref. 4) and Brandt (Ref. 20). A further development of Lyubov's method is a theory taking into account the concentration stresses. Calculation data of works (Refs. 20, 21, 28) and of experimental results of works (Refs. 22, 23) are compared. A formula is suggested for the approximate calculation of the diffusion activation energy (q) calculated for carbon steel, q = 1 kcal/mole (ω = 0.2; C = 0.03 atomic parts. The author considers further perlite growth studies necessary to clarify by theoretical analysis the causes of the inhibiting effect of molybdenum, chrome and tungsten. The concentration stresses forming during perlite growth in alloy steel

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are explained by heterogeneity of the carbon concentration in steel, as well as uneven distribution of the alloying element. There is 1 figure and 29 references: 20 Soviet, 7 English, 1 Polish and 1 not identified.

ASSOCIATION: Mordovskiy gosudarstvennyy universitet (Mordva State University)

SUBMITTED: October 21, 1959

86232

S/032/60/026/008/030/046/XX
B020/B052

5.5500 1273, 1350 1153

AUTHOR: Aleksandrov, L. N.

TITLE: Radiometric Determination of Thorium in Tungsten and Molybdenum

PERIODICAL: Zavodskaya laboratoriya, 1960, Vol. 26, No. 8, pp. 975-977

TEXT: The above method is based on the measurement of the natural α-radiation intensity of the isotope $_{90}Th^{232}$ for which no standards of special samples are necessary. The thorium content in the different stages during the preparation of products from tungsten and molybdenum can thus be easily determined. Fig. 1 gives the block diagram of the recording device. The sample was fixed at a certain distance from the screen and parallel to it. A standard plate coated with ZnS and activated with silver, was used as screen. Screen and photoelectric multiplier of the type ФЭУ-19 (FEU-19) were installed in the lighttight casing of the high-voltage rectifier type "Orekh". Noise impulses were eliminated by the method of amplitude selection by using a discriminator or by changing the anode

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Radiometric Determination of Thorium in Tungsten and Molybdenum

S/032/60/026/008/030/046/XX
B020/B052

voltage of the FEU, and the amplification coefficient of the amplifier. The impulses were recorded by the device ПС-10000 (PS-10000), or the Б-2 (B-2) radiometer with an α-scintillation chamber of the type П-349-2 (P-349-2). The width of the active part of the sample λ has to be determined for each direction θ in dependence on the distance R of the sample from the screen (Fig. 2). The examples given in the table are the results of the thorium determination in tungsten wire of different types, batches, and diameters, and the results of chemical analysis. They show that the maximum error in the thorium determination with a sample length of 200 mm in wires more than 0.15 mm thick, is 5%. This warrants an accuracy of thorium determination of up to 0.05%. The results can be rendered more exact by using longer samples with diameters of 10 - 15 mm and by extending the time of impulse counting. The thorium determination by the method suggested here, takes 5 - 10 minutes. The sample is conserved, and the change of the thorium content during annealing and sintering can be controlled. There are 2 figures, 1 table, and 2 Soviet references.

ASSOCIATION: Gosudarstvennyy nauchno-issledovatel'skiy institut istochnikov sveta (State Scientific Research Institute of Light Sources)

ALEKSANDROV, L.N.

Theory of the recrystallization of metals and alloys. Izv.vys.ucheb. zav.; fiz. no.2:77-84 '61. (MIRA 14:7)

1. Mordovskiy gosuniversitet.
(Metal crystals--Growth)

ALEKSANDROV, L.N.

Kinetics of the diffusive decomposition of oversaturated solid solutions. Izv.vys.ucheb.zav.; fiz. no.4:102-109 '61. (MIRA 14:10)

1. Mordovskiy gosudarstvennyy universitet.
(Diffusion) (Solutions, Solid)

S/137/62/000/012/034/085
A006/A101

AUTHOR: Aleksandrov, L. N.

TITLE: On the problem of the effect of admixtures upon the activation energy of recrystallization in tungsten and molybdenum

PERIODICAL: Referativnyy zhurnal, Metallurgiya, no. 12, 1962, 54, abstract 12I321 ("Uch. zap. Mordovsk. un-t", 1961, no. 18, 3 - 13)

TEXT: On the basis of literature data, the conclusion is drawn that the magnitude of recrystallization activation energy may serve as an indicator of the content of impurities and, consequently, of the quality of W and Mo wires. According to data, given in literature sources, the author calculates the magnitudes of recrystallization activation energy of W and Mo wires with a different content of impurities and at different compression degrees. There are 19 references.

P. Zubarev

[Abstracter's note: Complete translation]

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L 16192-63 EWT(1)/EWT(m)/BDS AFFTC/ASD

ACCESSION NR: AR3005162 S/0058/63/000/00[illegible]/E046/E046

55

SOURCE: RZh. Fizika, Abs. 6 E304

AUTHORS: Aleksandrov, L. N.; Skelkonogov, V. Ya.

TITLE: Study of diffusion and self diffusion in solids with alpha and beta radioactive isotopes 19

CITED SOURCE: Uch. zap. Mordovsk. un-t, no. 18, 1961, 39-44

TOPIC TAGS: diffusion in solids, self diffusion in solids, radioactive tracing, alpha active isotope, beta active isotope, scintillation counting

TRANSLATION: Unlike the existing method of determining the concentrations of alpha-active isotopes and the diffusion coefficient with the aid of thick-emulsion photographic plates, a method has been developed for the determination of the diffusion coefficients with the aid of alpha and beta active isotopes, using the scintillation counting method. Owing to the high coefficient of absorption of the radioactive radiation, the thickness of each layer in which the concentration of the diffusing substance is investigated does not exceed the radiation range. The

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latter circumstance makes it possible to determine directly the concentration of radioactive substance in the layer without introducing corrections for the radiation from the deeper lying layers. A. Khachaturyan.

DATE ACQ: 15Jul63 Sub Code: PH ENCL: 00

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S/070/61/006/001/011/011
E032/E514

AUTHORS: Lyubov, B.Ya. and Aleksandrov, L.N.

TITLE: First Symposium on the Growing of Crystals of Various Metals

PERIODICAL: Kristallografiya, 1961, Vol.6, No.1, pp.150-151

TEXT: The Scientific Committee of the Academy of Sciences USSR concerned with the formation of crystals is currently organizing a series of sections dealing with the more important aspects of the problem. So far, the following sections have been set up: growth of crystals of metals, semiconductors, and piezo and ferroelectrics. A further section is concerned with the theory of the growing of crystals. It is intended to promote regular symposia on these topics. The present note reports a summary of the proceedings of the first symposium organized by the above committee. The symposium took place on October 24-26, 1960 at the Institut Kristallografii AN SSSR (Institute of Crystallography, AS, USSR), Moscow. Fifty representatives of the institutes of the AS,USSR, scientific research establishments and institutes of higher education in Moscow, Leningrad, Kiyev, Sverdlovsk, Khar'kov and others took part. Eleven papers and a number of other communications

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were read. The symposium was opened by N. N. Sheftal' (deputy chairman of the above scientific committee) and by the chairman of the section concerned with the growing of crystals of metals, B. Ya. Lyubov. The following papers were among those read: Academician A. V. Shubnikov spoke on investigations of the crystallization process of ammonium chloride in a drop. V. T. Borisov and A. I. Dukhin (Institut metallovedeniya i fiziki metallov TsNIIChM, Institute of Metal Science and Physics of Metals of the Central Scientific Research Institute of Ferrous Metallurgy) reported on studies of the kinetics of the growth of crystals of cadmium. Ye. O. Esin and A. A. Kralina reported on the growth and the substructure of tin which was investigated at the Institut fiziki metallov AN SSSR (Institute of Physics of Metals, AS,USSR) at Sverdlovsk. L. Ye. Ovsiyenko, Ye. I. Sosnina and I. I. Zasimchuk, Institut metallofiziki AN UkrSSR (Institute of Metals Physics, AS, UkrSSR) discussed the conditions under which aluminium crystals are grown and the effect of these conditions on the degree of perfection of these crystals. They also considered effects such as diffusion and creep in these crystals. A. I. Bykhovskiy, L. N. Larikov and D. Ye. Ovsiyenko discussed the connection between the rate of

crystallization during the $\alpha \rightleftarrows \beta$ transformation of paradichlorobenezene and the super-cooling on the separation boundary between the phases. Further discussion of this work was given by A. A. Chernov (Institute of Crystallography, AS, USSR). V. G. Borisov spoke on the simultaneous solution of the thermal conductivity and diffusion problems in the case of the crystallization of a binary alloy in the absence of diffusion super-cooling. V. A. Timofeyeva, L. D. Prokhorov, A. I. Malyshev and N. A. Anisimov (Institute of Crystallography, AS, USSR) reported on single crystals of copper, aluminium and nickel having a weight greater than 10 kg which they had grown in a special high temperature furnace. The apparatus can be used to grow pure single crystals of any metals with melting points below 1600°C. L. M. Soyfer and V. I. Startsev (IREA, Khar'kov) discussed the zone methods of purification and growing of high-purity single crystals of antimony and bismuth. N. A. Brilliantov and L. S. Starostina (Institute of Crystallography) reported on a similar method used to grow molybdenum crystals. V. F. Miuskov (Institute of Crystallography, AS, USSR) read a paper on the growing of single crystals of molybdenum in vacuum, using high heating rates. Direct heating of the specimen by an electric

current was used. L. N. Aleksandrov (Saransk) reported on the kinetic parameters of formation of single crystals of tungsten. A film on the growing of crystals was shown by Academician A. V. Shubnikov and V. F. Parvov. The next symposium is planned for 1961.

ALEKSANDROV, L.N.

Thermodynamics of isothermal transformations in three-component systems. Fiz. met. i metalloved 11 no.3:435-442 Mr '61.
(MIRA 14:3)

1. Mordovskiy gosudarstvennyy universitet.
(Alloys—Thermal properties)(Phase rule and equilbrium)

26559

18.8200 9,4110 (1003, 1138, 1331) S/126/61/012/002/009/019
E202/E435

AUTHORS: Aleksandrov, L.N. and Mordyuk, V.S.

TITLE: The kinetics of the recrystallization of tungsten

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.12, No.2, pp.249-254

TEXT: The kinetics of the recrystallization of thoriated and pure tungsten wires of 50 to 200 μ diameter were studied in terms of the changes in their mechanical properties and microstructure in relation to the annealing temperature and ageing. Heating was carried out directly by passing an electric current through the wires and the temperature of annealing ranged from 800 to 2600°C with an accuracy of ± 20°C. The temperature was measured by means of a milliammeter calibrated by an optical pyrometer. Samples were subjected to various durations of annealing from 20 sec to 30 min. Since it was impossible to calculate the rate of growth of grains in the tungsten wire during the recrystallization from direct measurement, the kinetics of recrystallization were studied indirectly by finding the change in the tensile strength at ambient temperature in relation to the

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temperature and duration of annealing, and also by studying the microstructure and X-ray diffraction. Values of tensile strength were plotted vs. temperature of annealing for each duration of annealing and the resulting curves showed two characteristic regions - the first one corresponding to the primary recrystallization due to the heat treatment and the second one due to the coalescing recrystallization. It was also found that the relation between the log e of the time of completion of the primary recrystallization and the temperature of annealing was in each case linear. The latter plots were used to evaluate the activation energy of the primary recrystallization U, and the coefficient A, which in turn were used to solve the equation for the time of recrystallization t, viz:

$$t \approx A \exp\left(\frac{U}{RT}\right)$$

Evaluated in this manner, coefficients A for the 50 μ dia wires were in good agreement with the corresponding values obtained on the basis of the general theory of phase transition assuming three-dimensional growth of the recrystallization centres. On the other

hand, values of A for the 250 μ dia wires were in better agreement with a theoretical value based on the linear growth of the recrystallization centres, rather than the three-dimensional one. The curves of thoriated tungsten wires did not exhibit the characteristic displacement, from which it was concluded that the energy of activation of recrystallization in the region is infinitely large. Estimation of the beginning of the recrystallization according to the method of change in the mechanical properties gave lower temperature values than the customary estimation by inspection of the microstructure. In the opinion of the authors, the former method is capable of detecting the presence of grains which are not visible by inspection of the microstructure. The study of the coalescing (ultimate) recrystallization was not attempted. Acknowledgments are expressed to Yu.M.Aleksandrova and B.V.Potapov for assistance. There are 6 figures, 1 table and 7 references: 4 Soviet and 3 non-Soviet. The three references to English language publications read as follows: Burke J.E., Turnbull A.D. Progr. Metal. Phys., 1952, 3, p.220; Davis C.L. Metallurgia, 1958, 58, No.349, 228; Robinson C.S. J.Appl. Phys., 1942, 13,

The kinetics of the ... 16559

S/126/61/012/002/009/019
E202/E435

No.10, 627.

ASSOCIATION: Nauchno-issledovatel'skiy institut istochnikov sveta (Scientific Research Institute for Light Sources)

SUBMITTED: May 17, 1960 (initially)
January 4, 1961 (after revision)

Card 4/4

27485
S/053/61/075/001/003/003
B125/B108

187520

AUTHORS: Aleksandrov, L. N., and Lyubov, B. Ya.

TITLE: Theoretical analysis of the kinetics of decomposition of supersaturated solid solutions

PERIODICAL: Uspekhi fizicheskikh nauk, v. 75, no. 1, 1961, 117 - 150

TEXT: The present theoretical survey is based on experimental investigations by G. V. Kurdyumov (Problemy metallovedeniya i fiz. metallov., M., Metallurgizdat, Sb. za 1949, 1951, 1952, 1955, 1958 gg.), S. S. Shteynberg (Metallovedeniye, t. I., M., Metallurgizdat, 1952), S. T. Konobeyevskiy, and their teams. In one-component systems (e. g., in metals with polymorphism), regions with the structure of a new modification appear after cooling below the stability range of the high-temperature phase. These regions increase in size for thermodynamical reasons, and finally take possession of the whole volume of the system. Per unit time and unit volume, $I = (\alpha/v_0)\,(RT/h)\exp(-u/kT)\exp(-w/kT)$ (3), "germs" are transformed into centers. $w = (1/3)\sigma S_{cr}$, $S_{cr} = 4\pi\varrho_{cr}^2$, $\varrho_{cr} = 2\sigma/\Delta F_0$. Here,

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the regions smaller and larger than some critical dimensions are called "germs" and "centers", respectively. σ is the surface tension at the Phase boundary, ΔF_o - the variation of the free energy corresponding to the production of one unit volume of new phase, ϱ_{cr} - the radius of the critical germ, h - Planck's constant, v_o - the specific volume, u - the activation energy of the transition of atoms through the boundary between the two phases. α, $(1 < \alpha < 10)$, is a structural parameter. For $\left|\frac{\Delta F_o}{2RT}(1 - \frac{\varrho_{cr}}{\varrho})\right| << 1$ (5) the rate of the directed increase of the centers is equal to $v = \frac{d\varrho}{dt} = \frac{16\pi r_a^4 \Delta F_o}{9h}(1 - \frac{\varrho_{cr}}{\varrho})\exp(-u/kT)$ (4), where r_a is the atomic radius. If the phases are separated by a plane boundary, $dx/dt = (\Delta F_o/\pi h r_a^2)(v_o/N)^2 \exp(-u/kT)$ (7). From the ratio η = (converted volume/initial volume), the conversion time t can be found as a function

of temperature (A. N. Kolmogorov, Izv. AN SSSR, ser. fiz. no. 3, 365 (1937)). Investigations by B. Ya. Pines (ZhTF, 24, 1521 (1954), V. S. Gorskiy (Phys. Z. Sowietunion, 8, 457 (1935), S. T. Konobeyevskiy (ZhETF, 13, 200, 418 (1943)), M. I. Zakharova and N. F. Lashko (Izv. AN SSSR, ser. tekh., no. 7, 1015 (1946), and A. A. Bochvar concerning two-component systems are quoted. The kinetics of phase conversions in two-component systems are determined by the rate of "rebuilding" of the solvent lattice and by the diffusion rate of the dissolved component. The authors studied the separation of ferrite from undercooled austenite of pre-eutectoid composition. The centers are generated in the same manner as in a one-component system, and may be calculated by the general formula (3); in the general case

$$t_\eta = \left[-\frac{15h\ln(1-\eta)}{8\pi RTD_0^{3/2}\beta^3} \exp\left(\frac{W+U+\frac{3}{2}Q}{RT}\right) - \right.$$
$$\left. - \frac{5\pi^3 d^{12}(\Delta F_0)^3 \tau^4}{8\cdot 3^6 h^3 D_0^{3/2}\beta^3} \exp\left(\frac{\frac{3}{2}Q-3U}{RT}\right) + \tau^{3/2}\right]^{2/5}. \quad (97)$$

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holds, where U = Nu, W = Nw, N - Avogadro's number. For $t \ll \tau$, the kinetics of conversion are characterized by the rate of conversion. In three-component systems, the third element may considerably change the critical size g_{cr} of the centers of the new phase. Therefore, it may increase or decrease the effect of the mechanism of "rebuilding" the new lattice in phase conversion. In an iron-carbon-chromium system, for instance, the effect of chromium increases g_{cr} considerably and, therefore, also stresses the influence of the rebuilding mechanism. There are 27 figures and 65 references: 57 Soviet and 8 non-Soviet. The three most recent references to English-language publications read as follows: D. Turnbull and J. Fischer, J. Chem. Phys. 17, 71 (1949); J. Frye, E. Stansbury, D. McElroy, Trans. AIME 197, 219 (1953); R. W. Parsell and R. F. Mehl, Trans. AIME 194, 771 (1952).

L 19393-63 EWT(1)/EWP(q)/EWT(m)/EWP(B)/BDS AFFTC/ASD/ESD-3/IJP(C) JD/JG
ACCESSION NR: AT3001927 S/2912/62/000/000/0288/0291

AUTHOR: Aleksandrov, L. N.

TITLE: On some characteristics of the change of the imperfection of a structure during recrystallizational growth of crystals

SOURCE: Kristallizatsiya i fazovyye perekhody. Minsk, Izd-vo AN BSSR, 1962, 288-291

TOPIC TAGS: crystal, crystallization, crystallography, anneal, cold-working, cold-worked, metal, deformed, deformation, recrystallization, recovery, recrystallizational, microhardness, fibrous, polygonal, structure, Mo

ABSTRACT: The paper describes the results of an experimental investigation intended to establish the characteristics of the changes of imperfections in the structure of recrystallizing metals. The basic laws governing the recrystallizational growth of crystals in W are examined by the author in a paper that appears in the same compendium on pp. 292-306. The present test series is concerned with the changes in the imperfections of the structure during the recrystallization (RC) growth of crystals in Mo. Investigations were performed on wire specimens 0.4 mm diam. Impurity content (weight percent) Fe_2O_3 0.012, Ni 0.001, CaO 0.006, SiO_2 0.007. The observational methods (X-ray microstructural analysis, microhardness (MH) measurements, etc.) are described. The specimens were vacuum-annealed.

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L 19595-63

ACCESSION NR: AT3001927

5

Comparative graphs of the change of the MH with temperature (T) for a 1-hr and a 1-min anneal are shown; apparent anomalies in MH are attributed to the nonhomogeneity of the structure, which consist of large elongated crystals, small crystals, and new crystals with a lower MH and dislocation density. The changes in microstructure with anneal T are shown microphotographically. It is shown that beyond 800°C the fibrous structure is replaced by a polygonal structure and that at that T the magnitude of the microdistortions increases. A thermodynamic analysis shows that the crystal-growth processes during RC proceed with a decrease in free energy. Inasmuch as up to 90-99% of the energy accumulated during the static deformation of a metal goes to static distortions, a small increase of microstresses of the second kind during recrystallization with an overall decrease in elastic energy appears fully possible. "In conclusion I express my gratitude to Yu. M. Aleksandrova for the MH measurements, G. P. Mordyuk for the X-ray diffraction analysis, and M. B. Talalayevskiy for the chemical analysis of the specimens, also to the participants in the Second Symposium on the Theory and Practice of the Growth of Metallic Crystals for their useful discussion of my results." Orig. art. has 4 figs.

ASSOCIATION: none

SUBMITTED: 00 DATE ACQ: 16Apr63 ENCL: 00

SUB CODE: CH, PH, MA, EL NO REF SOV: 004 OTHER: 001

Card 2/2

L 19394-63 EWT(1)/EWP(q)/EWT(m)/EWP(B)/BDS AFFTC/ASD/ESD-3/IJP(C) JD/JG
ACCESSION NR: AT3001928 S/2912/62/000/000/0292/0307

AUTHOR: Aleksandrov, L. N.

TITLE: To the theory of the recrystallizational growth of crystals

SOURCE: Kristallizatsiya i fazovyye perekhody. Minsk, Izd-vo AN BSSR, 1962, 292-307.

TOPIC TAGS: crystal, crystallization, crystallography, recrystallization, anneal, cold-working, cold-worked, metal, deformed, deformation, recovery, recrystallizational, microhardness, Mo, Ta, W.

ABSTRACT: This paper deals with the theory and reports some experimental data on the making of single crystals (SC) by means of recrystallization (RC) which Chokhral'skiy obtained first in 1916 from wire specimens of plastically deformed metals. The freedom from surface defects of such SC's makes them especially suitable for physical investigations. The growing of SC's in the solid phase is especially convenient for the more refractory metals. Development of a theory of the recrystallizational growth of crystals will permit an improvement in the dependability of various electrovacuum instruments in which W, Mo, and Ta are employed at temperatures (T) that exceed the T of RC. The kinetics of the

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L 19394-63

ACCESSION NR: AT3001928

growth of crystals can be described on the basis of the general theory of phase transitions in solids and is characterized by the magnitude of the energy of RC activation, the change in free energy of the deformed metal, and the distribution of impurities, vacancies, and dislocation density. The paper develops certain general statements; experimental investigations of the growth of crystals during the RC of W support the position taken. The paper discusses the kinetics of RC, the RC of work-hardened areas, and collective RC. The energy of activation of the RC of cold-worked areas is judged from the curves of the change of the ultimate strength, the microhardness, the internal friction, and the X-ray pictures as functions of anneal time and T. At elevated T the total rate of the growth of crystals is governed by the rate of growth and the rate of new-phase nucleation. During RC a decrease occurs in the energy and the dislocation density of the deformed metal. This confirms the measured broadening of the lines on the X-ray diffraction spectra and the number of etching dimples on the surface of the crystal. The growth of crystals during collective RC is accompanied by an enhanced impurity diffusion on the boundaries which, together with an increased vacancy concentration, results in a growth of the electric resistivity. The growing of large SC by the RC method requires a preliminary low-T anneal to decrease the number of centers formed. Orig. art. has 10 figures and 20 numbered equations.

Card 2/3

L 19394-63

ACCESSION NR: AT3001928 0

ASSOCIATION: none

SUBMITTED: 00 DATE ACQ: 16Apr63 ENCL: 00

SUB CODE: CH, PH, MA, EL NO REF SOV: 017 OTHER: 007

Card 3/3

S/170/62/005/009/004/010
B108/B104

AUTHOR: Aleksandrov, L. N.

TITLE: Contamination of tungsten by diffusion of carbon from graphite lubricant

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, v. 5, no. 9, 1962, 53-58

TEXT: The diffusion of carbon into VA-3 (VA-3) tungsten wire at temperatures of up to 900°C was studied with the aid of C^{14} tracer isotope. Wire samples were coated with a specially prepared graphite lubricant containing C^{14} and annealed at 110, 450 and 900°C for 1 to 4 hours. The diffusion coefficient D was determined by β-activity measurements. From $D = D_0 \exp(-Q/RT)$, the activation energy Q of diffusion at 900°C was determined to: $Q = 61.5 \pm 1.5$ kcal/g-atom. The mean value of D at 900°C is $2.2 \cdot 10^{-12}$. This result is consistent with those got by thermionic emission tests. The possibility of separating diffusion in a polycrystal into intragranular and intergranular diffusion is pointed out:

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$$D_{intra} = 0.1086(x_{i+1}^2 - x_i^2)/t \log(n_i x_i / n_{i+1} x_{i+1}),$$

$$D_{inter} = 1.32 \gamma_0 \sqrt{D_{intra}} / a_0 \sqrt{t((n_i - n_{i+1})/(n_i x_{i+1} - n_{i+1} x_i))}.$$

a_0 - mean width of the grain boundaries, γ_0 - constant of distribution of the equilibrium concentration between the bulk of the grain and its boundary. Attention is drawn to the possible contamination of tungsten wire and tubes by carbon through the use of graphite lubricant during manufacture. There are 1 figure and 4 tables.

ASSOCIATION: Mordovskiy gosudarstvennyy universitet, g. Saransk.
(Mordovian State University, Saransk)

SUBMITTED: November 20, 1961

37708

S/126/62/013/004/022/022
E193/E383

18,1152

AUTHOR: Aleksandrov, L.N.

TITLE: Internal friction of tungsten

PERIODICAL: Fizika metallov i metallovedoniye, v. 13, no. 4, 1962, 656 - 659

TEXT: The temperature-dependence of internal friction Q^{-1} of tungsten was determined by the torsion-pendulum method applied to wire specimens, prepared by powder metallurgy and containing the following impurities (wt.%): Al_2O_3 - 0.001; Fe_2O_3 - 0.004; SiO_2 - 0.043; MO - 0.005 . The temperature-dependence of shear modulus G was also determined. The results of internal-friction masurements are reproduced in Fig. 1, where $Q^{-1} \times 10^3$ is plotted against the test temperature (^{o}C), the various curves relating to: 1 - specimen heated without preliminary heat-treatment; 2 - specimen annealed for 5 min at 1 700 ^{o}C; specimen annealed for 1 min at 2 400 ^{o}C. The activation energy H of the process responsible for the first internal-friction peak (about 1 450 ^{o}C) on

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Internal friction of tungsten

curve 1 was found to be 115 kcal/g.at., which was near to the value of the activation energy for recrystallization of cold-worked tungsten. Since, in addition, this peak was much less pronounced on curve 2 (for the partially annealed material) and disappeared completely on curve 3 (for fully annealed material) and since the existence of this peak was associated with the polycrystalline character of tungsten, it can be assumed that this peak is caused by relaxation along the grain boundaries. The activation energy for the process responsible for the second peak at about 1 900 °C, which is clearly defined on curves 1 and 2 but hardly discernible on curve 3, was found to be about 148 kcal/g.at., which is near to the activation energy for the self-diffusion of tungsten or for diffusion of various impurities in this metal. It was inferred from this that the second internal-friction peak was associated with impurities (Fe, Al, Mo) present in the metal studied; annealing at temperatures higher than 1 700 °C caused diffusion of the impurities to the grain boundaries, as a result of which the

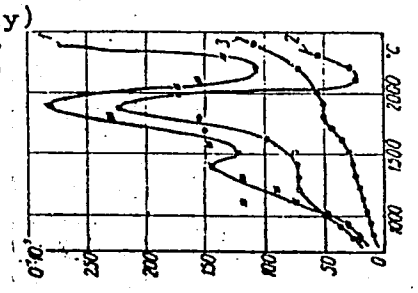
Internal friction of tungsten

height of the peak decreased. Regarding the shear modulus of tungsten, the temperature-dependence of G had a minimum at a temperature corresponding to that of the second internal-friction peak, the value of G of annealed material increasing within the entire temperature range studied.
There are 3 figures.

ASSOCIATION: Nauchno-issledovatel'skiy institut istochnikov sveta (Scientific Research Institute of Light Sources)

SUBMITTED: July 14, 1961 (initially)
October 24, 1961 (after revision)

Fig. 1:



Card 3/3

ALEKSANDROV, L.N.

Effect of the degree of distortion of the crystal lattice of a luminophor on the brilliance of the luminescence. Discussion of the reports of M.A.Konstantinova-Shlesinger and A.A.Bundel'. Izv. AN SSSR. Ser. fiz. 26 no.4:532 Ap '62. (MIRA 15:4)
(Luminescent substances--Spectra) (Dislocations in crystals)

ALEKSANDROV, L.N.

Effect of the density of dislocations on the brightness of luminescent crystals. Izv. vys. ucheb. zav.; fiz. no.5:166-170 '63. (MIRA 16:12)

1. Mordovskiy gosudarstvenny universitet.

S/0139/63/000/006/0135/0144

ACCESSION NR: AP4025097

AUTHOR: Aleksandrov, L. N.

TITLE: On the kinetics of crystal growth in metals during recrystallization

SOURCE: IVUZ. Fizika, no. 6, 1963, 135-144

TOPIC TAGS: granule growth rate, recrystallization, molybdenum wire, stereometric metallography, x-ray photography, diffusional redistribution, activation energy

ABSTRACT: The time dependence of granule growth rate in recrystallization of metals is considered. Molybdenum wire specimens were produced by powder sintering. The size of the granules was measured continuously by means of stereometric metallography and x-ray photography. The crystal growth during recrystallization is explained by diffusional redistribution of vacancies (which often seems to limit the grouping process). The initial growth rate of granules during recrystallization in molybdenum wires is expressed by $k\ell nt$. The rate of crystal growth during recrystallization can be calculated using as activation energy atom transitions through the boundaries of effective recrystallization activation energy. "The author is grateful to Professor B. Ya. Lyubov for evaluating the results and to his co-workers

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ACCESSION NR: AP4025097

at the NIIIS Laboratory, B. V. Potapov, L. F. Savina, and V. S. Matrosova for helping in the experiments." Orig. art. has: 9 formulas, 8 firgures, and 1 table.

ASSOCIATION: Mordovskiy gosuniversitet (Mordovian State University)

SUBMITTED: 08Apr63 DATE ACQ: 14Feb64 ENCL: 00

SUB CODE: PH NO REF SOV: 014 OTHER: 008

Card 2/2

ACCESSION NR: AT4013949 S/2659/63/010/000/0193/0199

AUTHOR: Aleksandrov, L. N.

TITLE: The effect of admixtures and structural defects on recrystallization kinetics in metals

SOURCE: AN SSSR. Institut metallurgii. Issledovaniya po zharoprochny*m splavam, v. 10, 1963, 193-199

TOPIC TAGS: metal recrystallization, recrystallization kinetics, metal recrystallization structure dependence, metal recrystallization composition dependence

ABSTRACT: The investigation of recrystallization kinetics in pure metals and alloys is very important due to the wide use in engineering of operations near the melting points of these materials. The effect of admixtures on recrystallization kinetics is not completely understood. However, admixtures change the recrystallization activation energy U and the temperature of incipient recrystallization T_p. On the basis of L. N. Aleksandrov's article published in 1961 (Izv. vuzov, Fizika, No. 2, 77, 1961), the author evolves an equation for the duration of recrystallization

$$t = A \exp\left(\frac{U + \frac{1}{4}W}{RT}\right) = A \exp\frac{U_{эф}}{RT}.$$

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ACCESSION NR: AT4013949

The effect of Ni on the temperature of incipient recrystallization for a Fe-Ni alloy was then investigated (see Fig. 1 in the Enclosure). Fig. 2 in the Enclosure shows the variation in electrical resistance of Mo depending on the time of secondary annealing, which was investigated in order to evaluate the distribution of admixtures of Al_2O_3, Fe_2O_3, Ni, CaO, SiO_2 and Mo. The importance of vacancies for increasing the specific electrical resistance is more noticeable in tungsten than in molybdenum. It was found that in high-melting metals with admixtures, the effect of the admixture atoms on residual electrical resistance after recrystallization is higher than the effect of vacancies and dislocations. The effect of admixtures is highest at low concentrations (up to 0.1% by weight). Monocrystals should be investigated to determine the influence of vacancies on the increase in electrical resistance during recrystallization. It is also advisable to perform direct electronic microscopic and autoradiographic observations on the migration of admixture atoms during annealing. Determination of the recrystallization kinetics of metals with admixtures will improve the quality of both existing and new high-melting and heat resistant alloys. Orig. art. has: 3 figures and 9 equations.

ASSOCIATION: Institut metallurgii AN SSSR (Institute of Metallurgy, AN SSSR)

SUBMITTED: 00 DATE ACQ: 27Feb64 ENCL: 02

SUB CODE: ML NO REF SOV: 013 OTHER: 001

Card 2/4

ACCESSION NR: AT4013950 S/2659/63/010/000/0199/0201

AUTHOR: Aleksandrov, L. N.

TITLE: The possibility of describing and calculating the grain growth rate during metal recrystallization by the vacancy displacement method

SOURCE: AN SSSR. Institut metallurgii. Issledovaniya po zharoprochny*m splavam, v. 10, 1963, 199-201

TOPIC TAGS: grain growth rate, metal recrystallization, molybdenum, vacancy displacement, molybdenum recrystallization

ABSTRACT: S. D. Gertsriken and M. M. Novikov have shown that the concentration of atomic defects in the crystal lattice (vacancies) is directly proportional to the deformation. This was proven during an investigation of the decrease in metal volume after annealing. Investigations by the author and those in the Institut metallurgii imeni Baykova (Baykov Metallurgical Institute) by N. V. Grevtsev and G. N. Klebanov on variations in molybdenum grain size show that at first the grain size changes according to the following law: $D = k \ln t + D_0$, i.e. the relationship between rate and time is: $v = const/t$. The work of S. Z. Bokshteyn, S. T. Kishkin and others on vacancy stabilization in strained metal samples corroborates the model proposed by the author for grain growth during recrystallization. The

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ACCESSION NR: AT4013950

grain boundaries shift when the atoms pass through the vacancies during vacancy accumulation at the boundary. The atoms also exchange places through the vacancies. This also confirms that the boundary shifting rate should be limited by the diffusive mobility of the vacancies in the recrystallized metal. Orig. art. has: 1 figure and 5 formulas.

ASSOCIATION: INSTITUT METALLURGII AN SSSR (Metallurgical Institute AN SSSR)

SUBMITTED: 00 DATE ACQ: 27Feb64 ENCL: 00

SUB CODE: ML NO REF SOV: 003 OTHER: 001

Card 2/2

ALEKSANDROV, L.N.; LYUBOV, B.Ya.

Theory of the growth of beinite crystals in the intermediate transformation of austenite. Dokl. AN SSSR 151 no.3:552-555 Jl '63. (MIRA 16:9)

1. Mordovskiy gosudarstvennyy universitet i Institut metallovedeniya i fiziki metallov TSentral'nogo nauchno-issledovatel'skogo instituta chernoy metallurgii im. I.P.Bardina. Predstavleno akademikom G.V.Kurdyumovym.

(Crystals--Growth) (Austenite)

ACCESSION NR: AP4011774 S/0181/64/006/001/0307/0307

AUTHORS: Aleksandrov, L. N.; Kogan, A. M.

TITLE: The strength of acicular crystals of tungsten

SOURCE: Fizika tverdogo tela, v. 6, no. 1, 1964, 307

TOPIC TAGS: acicular crystal, tungsten, tungsten crystal, strength, tensile strength, microhardness, dislocation density

ABSTRACT: Acicular crystals of W were obtained during thermal decomposition of tungsten oxide and subsequent precipitation of W-atoms on a W-filament of a quartz heat lamp. Needles forming on the filament reached lengths up to 1 mm and diameters of 10 to 70 mμ. Etch pits showed no lateral faces, indicating that the dislocation density was less than 10^4 cm^{-2}. In the W-base (filament), the dislocation density was $10^7 cm^{-2}$. Measurements of microhardness normal to the direction of growth gave a value of 354 kg/mm^2, which is a characteristic value for single crystals of W. The cohesive force between many needles and the filament was negligible. A force of 30-40 dynes was sufficient to tear away most, regardless of dimensions. However, some crystals (probably those growing in lattice

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ACCESSION NR: AP4011774

continuity with the filament) required more force, the amount depending on their diameters. The relationship of needle strength to diameter is illustrated in Fig. 1 of the Enclosure. One crystal had a strength of 1320 kg/mm^2, which approaches the theoretical value. Ordinary W-wire of the same size has a tensile strength not exceeding 500 kg/cm^2. Orig. art. has: 1 figure.

ASSOCIATION: Mordovskiy gosudarstvenny*y universitet, Saransk (Mordovian State University)

SUBMITTED: 13May63 DATE ACQ: 14Feb64 ENCL: 01

SUBCODE: PH NO REF SOV: 005 OTHER: 002

Card 2/[illegible]

ACCESSION NR: AR4041602 S/0137/64/000/005/I033/I033

SOURCE: Ref. zh. Metallurgiya, Abs. 51203

AUTHOR: Aleksandrov, L. N.

TITLE: Relaxation oscillator of direct heating

CITED SOURCE: Sb. Relaksats. yavleniya v met. i splavakh. M., Metallurgizdat, 1963, 65-71

TOPIC TAGS: relaxation oscillator, direct heating, internal friction, shear modulus

TRANSLATION: Construction of relaxation oscillator for measurement of internal friction and relative shear modulus of refractory metals was developed in which the principle of direct electric heating in vacuum of 10^{-3} - 10^{-4} mm Hg was used. Temperature of heating is measured by magnitude of current with help of ammeter calibrated with optical pyrometer according to standard sample. Accuracy of determination of temperature amounts to $\pm 20°$ and can increased to ± 2 - 5° by means of use of microsupports OP-48 and EOP-51. Construction of relaxation oscillator allows us to make visual, photographic, and also automatic registration of oscillations.

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ACCESSION NR: AR4041602

Thanks to small thermal inertness, the instrument permits to study kinetics of certain processes in solid bodies more exactly and completely than with the help of the usual relaxation oscillator of indirect heating. Influence of temperature of experiment and temperature of annealing on character of internal friction of wire samples W of different purity was investigated. First peak of internal friction on temperature curve at 1300 - 1500° is connected with processes accompanying recrystallization. Activation energy of 1st peak [~ 110 kilocalorie/k-atom (sic)] is close to activation energy of recrystallization. Height of this peak drops with completion of primary recrystallization; however it does not disappear after annealing leading to the formation of macrocrystalline structure. For W with additions of VA-3, VT-7, VT-10, VT-15 the height of 1st peak on initial curve is significantly lower than for pure W of high frequency. Second peak of internal friction at 1800 - 1900° is "grainborder"; isothermal holding of samples at 2300° for 11 sec completely destroys both peaks. Third peak of internal friction (at 220 - 2300°) has activation energy ~142 kilocalorie/g-atom, which is close to activation energy of diffusion of Ge in W. According to results of investigation of temperature dependency of internal friction the inclination of W-wires to creep at high temperatures is determined and activation energy of processes causing low and high-temperature branchs of background of internal friction is determined. Bibliography: 16 references.

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ACCESSION NR: AR4041602

SUB CODE: EC, MM ENCL: 00

Card 3/3

ACCESSION NR: AR4046012 S/0058/64/000/007/E076/E076

SOURCE: Ref. zh. Fizika, Abs. 7E580

AUTHORS: Aleksandrov, L. N.; Orlov, V. N.

TITLE: On the connection between the recrystallization kinetics and the stress relaxation in metals

CITED SOURCE: Sb. Relaksats. yavleniya v met. i splavakh. M., Metallurgizdat, 1963, 294-299

TOPIC TAGS: recrystallization, stress relaxation, internal friction, activation energy, tungsten, molybdenum

TRANSLATION: The temperature and time dependences of internal friction (IF) were investigated in non-recrystallized and in recrystallized wires of tungsten and molybdenum. Two peaks were observed on the temperature curve of the IF. Recrystallization greatly reduces

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ACCESSION NR: AR4046012

the first peak and lowers the second; after selective recrystallization, the second peak in tungsten disappears almost completely. The temperatures and activation energies of the peaks amount to 1400C and 1115 kcal/g-atom and 1950C, 150 kcal/g-atom respectively for tungsten, and 1000C, 87 kcal/g-atom and 1450C, 118 kcal/g-atom respectively for molybdenum. The activation energies of the relaxation process corresponding to the first peak are close to the activation energy of the crystallization, and this peak is apparently due to relaxation over the grain boundaries. The relaxation process causing the second peak has an activation energy close to the activation energy of self diffusion or diffusion of impurities in the investigated metals. The contribution of vacancies (measurements at 100C after cooling from 2400C) and of dislocations (comparison with the dislocation density determined by the x-ray structural method) to IF are analyzed. Relaxation curves are plotted in the temperature interval 500--2700C. Opinions are advanced concerning the nature of the relaxation processes. L. Mirkin.

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ACCESSION NR: AR4046012

SUB CODE: MM, SS ENCL: 00

Card 3/3

L 14355-65 AFWL/SSD/AEDC(b)/ASD(m)-3
ACCESSION NR: AR4045217 S/0277/64/000/007/0033/0033

SOURCE: Ref. zh. Mashinostr. mat., konstr. i raschet detal. mash. Otd. vy*p., Abs. 7.48.229

AUTHOR: Aleksandrov, L. N.; Mordyuk, V. S.

TITLE: Direct heat relaxer

CITED SOURCE: Sb. Relaksats. yavleniya v met. i splavakh. M., Metallurgizdat, 1963, 65-71

TOPIC TAGS: relaxation, internal friction, shear modulus, high temperature metals, direct current heating, oscillation recording, tungsten

TRANSLATION: A relaxer has been designed for measuring internal friction and relative shear modulus in high temperature metals using the principle of direct current heating in a vacuum of 10^{-3} to 10^{-5} mm Hg. The design of the relaxer makes it possible to carry out visual, photographic, and also automatic recording of oscillations. The influence of experimental temperatures and annealing temperatures

Card 1/2

L 14355-65
ACCESSION NR: AR4045217

on the nature of internal friction in W samples of various degrees of purity was investigated. Results of an investigation of the temperature dependence of internal friction showed a tendency of W-wire to creep at high temperatures. 16 literature titles.

SUB CODE: MM, TD ENCL: 00

Card 2/2

L 15000-65 EWT(m)/EWP(w)/EPF(n)-2/EWA(d)/EWP(t)/EWP(b) Pu-4
ASD(f)-2/ASD(m)-3 JD/JG/MLK

ACCESSION NR: AT4048137 S/0000/63/000/000/0294/0299

AUTHOR: Aleksandrov, L.N., Orlov, V.N. B

TITLE: Relationship between the kinetics of recrystallization and stress relaxation in metals 18

SOURCE: Vsesoyuznaya konferentsiya po relaksatsionny*m yavleniyam v metallakh i splavakh. 3d, Voronezh, 1962. Relaksatsionny*ye yavleniya v metallakh i splavakh (Relaxation phenomena in metals and alloys); trudy* konferentsii. Moscow, Metallurgizdat, 1963, 294-299

TOPIC TAGS: tungsten, molybdenum, tungsten recrystallization, stress relaxation, molybdenum recrystallization, internal friction 18

ABSTRACT: The authors investigated the relationship between the recrystallization kinetics and stress relaxation by studying the variation of internal friction depending on temperature and time. This was done by means of a direct electrical heating, vacuum-type, relaxation device with low thermal inertia using tungsten and molybdenum samples. Recrystallization significantly lowers the first maximum of internal friction on the curve of tungsten and practically abolishes the second one, leaving only a trace. The second maximum remains for molybdenum since the structure is polycrystalline with larger

Card 1/3

ACCESSION NR: AR4018331 S/0137/64/000/001/I042/I043

SOURCE: RZh. Metallurgiya, Abs. 1I275

AUTHOR: Aleksandrov, L. N.

TITLE: Studying tungsten at high temperatures

CITED SOURCE: Tr. Kuyby*shevsk. aviats, in-t, vy*p. 16, 1963, 259-266

TOPIC TAGS: tungsten; high-temperature tungsten treatment, specific electrical resistance

TRANSLATION: High-temperature internal friction and the change in specific electrical resistance ρ after high-temperature annealing of wire samples of type VA-3 tungsten were studied. The temperature curve of the function of internal friction has peaks at 1,500, 1,900, and 2,200 degrees. The energy of activation of the relaxation process H is equal to 120, 148, and 165 kilocalorie/grams-atom respectively. The first internal friction peak, which disappeared during the process of measurement as a result of recrystallization processing, is linked to the relaxation of tensions along the boundaries of the grains, and the energy of activization matching it is approximately equal to the energy of activization of the recrystallization of tungsten. The second and third peaks, evidently, are governed by the

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ACCESSION NR: AR4018331

diffusion of admixtures (Fe, Al, Mo, and O_2)/ on the boundaries of stable large grains, which are formed during collector recrystallization. With the raising of the temperature, P is lowered to 2,100-2,300 degrees, and increases as the temperature is increased further. In thin filaments, the rise in electrical resistance occurs later. Evaluation shows that one should not consider an increase in electrical resistance to be wholly governed by an increase in the concentration of vacancies. Initial annealing of samples at 2,600 degrees significantly levels off the observed minimum on the curve of electrical resistance, and the slow cooling of the annealed samples, during which time the vacancies that are formed should disappear, hardly changes the relationship established. Consequently, the included admixtures play the decisive role in increasing electrical resistance.

SUB CODE: MM ENCL: 00

Card 2/2

L 6910-65 EWA(k)/EWT(1)/EEC(t) APGC(b)/AFWL/ESD(gs)/ESD(t)
ACCESSION NR: AR4039924 S/0058/64/000/004/E052/E053

SOURCE: Ref. zh. Fiz., Abs. 4E405

AUTHORS: Aleksandrov, L. N.; Mordyuk, V. S.; Mordyuk, G. P.

TITLE: X ray structural investigation of dislocation density in crystal phosphors

CITED SOURCE: Uch. zap. Mordovsk. un-t, no. 15, ch. 1, 1963, 20-28

TOPIC TAGS: x ray structure analysis, luminor, zinc sulfide optic material, dislocation density, line broadening, luminescence quenching

TRANSLATION: The luminor $Ca_3(PO_4)_2.Ca(F, Cl)_2$, activated with Sb or Mn, and the luminor ZnS, activated with Cu, were investigated by a photographic method using copper radiation. The dislocation densities were determined from the square of the line broadening (θ_1 = 16°,

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L 6910-65
ACCESSION NR: AR4039924

= 23° 16') by the method of approximating the sizes of the mosaic blocks. After pulverization, the dislocation density increased from 5×10^{8} to 7.5×10^{10} cm^{-2}, and the block dimensions decreased from 8.3×10^{-5} to 0.87×10^{-5} cm. The data obtained imply that the extraction of the luminors following pulverization is due to the increase in the lattice distortions of the dislocation type, and also to the occurrence of microcracks on the grain surface. V. Landa.

SUB CODE: OP, SS ENCL: 00

Card 2/2

ALEKSANDROV, L.N., inzh.

Experimental study of turbulent flow in the boundary zone of a region of abrupt lateral expansion. Izv. VNIIG 73:233-245 '63

L 10730-65 EWT(m)/EPF(n)-2/EPR/EWP(b) Pc-4/Pu-4 ASD(m)-3/ASD(f)-2/AS(mp)-2
JD/JG/MLK
ACCESSION NR: AT4046830 S/0000/64/000/000/0125/0131

AUTHOR: Aleksandrov, L.N.; Mordyuk, V.S. B

TITLE: Estimation of the heat resistance of refractory metals on the basis of their internal friction 18 14 27

SOURCE: AN SSSR. Nauchnyy sovet po probleme zharoprochnykh splavov. Issledovaniya staley i splavov (Studies on steels and alloys). Moscow, Izd-vo Nauka, 1964, 125-131

TOPIC TAGS: tungsten, molybdenum, tungsten heat resistance, molybdenum heat resistance, tungsten internal friction, molybdenum internal friction, refractory metal

ABSTRACT: The use of tungsten as an incandescent light source at 2500-3000C (0.7-0.8 of the melting point) creates very high requirements for heat resistance at high temperatures. Tungsten alloys with aluminum, thorium and rhenium are commonly used for this purpose, but new tests are required to ensure stable properties in the alloys. The present article contains the results of an investigation of stress relaxation in tungsten and molybdenum wires with varying ultimate strength at high temperatures. An original relaxometer designed by the authors was used to measure the internal

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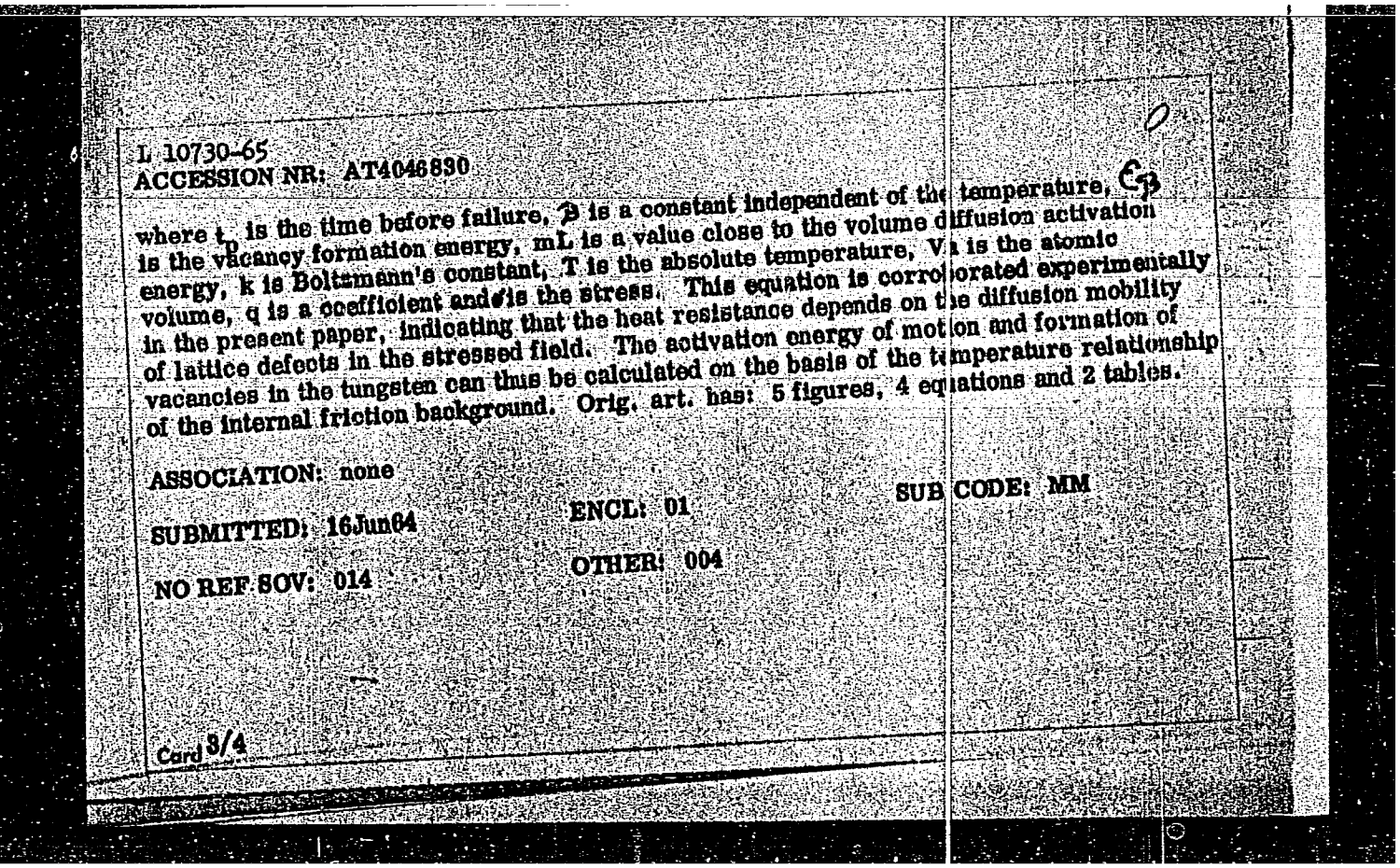
friction at temperatures up to 3000C. The ultimate strength varied from 8.3 to 12.7 kg/mm^2 for tungsten at 2000C and 4.3 to 6.4 kg/mm^2 for molybdenum at 1800C. During annealing at high temperatures, the internal friction drops significantly, showing that residual stress is removed and the crystal lattice is in equilibrium. The precise determination of the nature of the relaxation maxima on the internal friction curves will only become possible after future investigations. However, the activation energy of the process causing the given maximum can now be calculated. Analysis of the test results shows that the relaxation maxima are shifted toward higher temperatures in heat resistant metals (see Fig. 1 of the Enclosure). Miscrostructural investigations show results coinciding with the data on internal friction in that a sample with high heat resistance shows intensive grain growth at higher temperatures. In other words, the temperature of incipient recrystallization, which can be determined from the internal friction, is a reflection of the heat resistance. The well-know relationship between the time of sample failure at high temperatures and its mechanical properties was first found by S. N. Zhurkov, B.N. Narzulayev and G.P. Sanfirova and then worked out theoretically by K.A. Osipov and I. Ya. Degtyar:

$$t_p = B \exp \frac{e_0 + mL}{kT} \exp\left(-\frac{gV_a}{2kT}\sigma\right) \quad (1)$$



L 10730-65
ACCESSION NR: AT4046830

where t_p is the time before failure, β is a constant independent of the temperature, E_f is the vacancy formation energy, mL is a value close to the volume diffusion activation energy, k is Boltzmann's constant, T is the absolute temperature, V_a is the atomic volume, q is a coefficient and σ is the stress. This equation is corroborated experimentally in the present paper, indicating that the heat resistance depends on the diffusion mobility of lattice defects in the stressed field. The activation energy of motion and formation of vacancies in the tungsten can thus be calculated on the basis of the temperature relationship of the internal friction background. Orig. art. has: 5 figures, 4 equations and 2 tables.

ASSOCIATION: none

SUBMITTED: 16Jun64 ENCL: 01 SUB CODE: MM

NO REF SOV: 014 OTHER: 004

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L 10730-65
ACCESSION NR: AT4046830

ENCLOSURE: 01

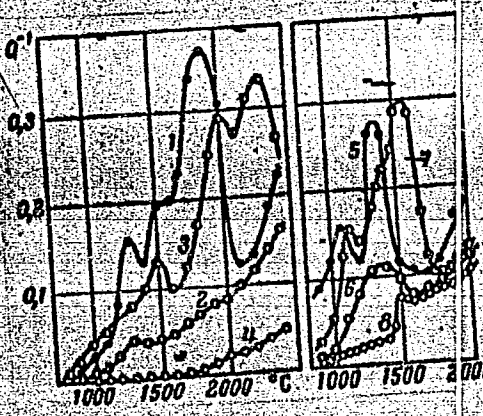

Fig. 1. Temperature displacement of internal friction curves of tungsten and molybdenum with various degrees of heat resistance: 1 - sample A, initial, 2-the same, recrystallized; 3-sample S, initial, 4-the same, recrystallized; 5-sample T, initial; 6-the same, recrystallized; 7-sample MCh, initial, 8-the same, recrystallized.

Card 4/4

ALEKSANDROV, L.N., doktor med. nauk; DYSKIN, Ye.A., doktor med. nauk; OZERETSKOVSKIY, L.B.

Erroneous theory of gunshot wound formation. Vest. khir. 92 no.5: 59-64 My '64. (MIRA 18:1)

1. Iz kafedry operativnoy khirurgii (nachal'nik - prof. A.N. Maksimenkov) Voyenno-meditsinskoy ordena Lenina akademii imeni S.M. Kirova. Adres avtorov: Leningrad, K-9, ul. Lebedeva, 37-a, kafedra operativnoy khirurgii Voyenno-meditsinskoy ordena Lenina akademii imeni S.M. Kirova.

ALEKSANDROV, L.N., doktor, med.nauk; DYSKIN, Ye.A., doktor med. nauk;
OZERETSKOVSKIY, L.B.

Mechanism of gunshot wounds of the extremities. Vest. khir. no.7:
79-85 Jl '64. (MIRA 18:4)

1. Iz kafedry operativnoy khirurgii (nachal'nik - prof. A.N.Maksimenkov)
Voyenno-meditsinskoy ordena Lenina akademii imeni Kirova.

ACCESSION NR: AP4044908 S/0226/64/000/004/0028/0032

AUTHOR: Aleksandrov, L.N., Shchelkonogov, V.Ya

TITLE: A study of the diffusion of carbon in tungsten and molybdenum at low carbon concentrations

SOURCE: Poroshkovaya metallurgiya, no. 4, 1964, 28-32

TOPIC TAGS: tungsten, molybdenum, carbon diffusion, metal diffusion, solid solution, transition element

ABSTRACT: Previous investigations of carbon diffusion in the refractory transition metals have not yielded uniform values for the diffusion parameters. The present authors therefore attempted to clarify the conditions of contamination of tungsten and molybdenum by carbon, and thus to determine its basic diffusion parameters. In their studies, the carbon concentrations were low enough to avoid the formation of tungsten carbide (W_2C) or molybdenum carbide (Mo_2C); therefore, carbon diffusion could be studied in solid solutions of W-C and Mo-C. Tests were performed on tungsten (type VRN) specimens 0.8 mm in diameter, and with molybdenum (type Mch) specimens 0.4 mm in diameter. The specimens, covered with a graphite lubricant mixed with

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ACCESSION NR: AP4044908

radioactive C^{14} in the proportion 1:20 were inserted in quartz containers having diameters 1.2X that of the specimen and were diffusion-annealed in a hydrogen atmosphere for one hour at 1100-1450C in a furnace. After annealing, the layers of the specimens were analyzed for radioactivity, penetrating into the specimen by removing successive 0.5-1 μ layers electrolytically (in a 10% NaOH bath at a current density of 950 ma/cm^2, for 5 minutes). During these measurements, the activity of the specimens was determined only by the exposed surface layer because of the soft β-radiation of C^{14}. Distribution of the concentration of the diffusing element with depth could be described by the equation

$$C_x = C \frac{h}{\sqrt{\pi D t}} \exp\left(\frac{-x^2}{4Dt}\right) \quad (1)$$

where x is the distance beneath the surface, t is the annealing time, D is the diffusion coefficient and h is the thickness of the original radioactive coating. At t = const, $\log n = \text{const} - \frac{x^2}{4Dt}$ where n is the recorded count. From the slope of the straight lines relating log n to x^2, the diffusion coefficients of carbon in tungsten and molybdenum could be computed. For tungsten, the values did not fall on one straight line in each

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ACCESSION NR: AP4044908

diagram. It is belived that the first slope corresponds to carbon diffusion in tungsten in the presence of microcarbides, while the second slope corresponds to carbon diffusion in pure tungsten with the formation of a solid solution. The temperature dependence of the diffusion coefficient in tungsten was calculated from the mean values obtained as

$$D = 4 \times 10^{-2} \exp\left(\frac{-27000}{T}\right)$$

at a depth down to 1.5-2μ, and

$$D = 0.3 \exp\left(\frac{-25000}{T}\right)$$ below that.

For the diffusion coefficient in molybdenum

$$D = 2.8 \times 10^{-4} \exp\left(\frac{-17250}{T}\right).$$

The energy of activation of the diffusion process was also determined. Penetration of carbon into tungsten and molybdenum to depths of 5 and 40μ, respectively, was observed with annealing times of 3.5 hours over a temperature range of 1100-1450C. Orig. art. has: 5figures and 3 formulas.

ASSOCIATION: Mordovskiy gosudarstvenny*y universitet (Mordovian State University)

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ACCESSION NR: AP4044908

SUBMITTED: 31Mar63 ENCL: 00 SUB CODE: MM

NO REF SOV: 007 OTHER: 002

Card 4/4

APPROVED FOR RELEASE: 06/05/2000 CIA-RDP86-00513R000100820020-8"

L 10819-66 EWT(m)/EWA(d)/T/EWP(t)/EWP(k)/EWP(z)/EWP(b)/EWA(c) IJP(c) MJW/JD/HW/JG

ACC NR: AR5023518 SOURCE CODE: UR/0275/65/000/008/A012/A013

SOURCE: Ref. zh. Elektronika i yeye primeneniye, Abs. 8A114

AUTHOR: Aleksandrova, Yu. M.; Aleksandrov, L. N.

TITLE: Determination of optimal temperature conditions for molding incandescent filament from tungsten produced by different manufacturers

CITED SOURCE: Uch. zap. Mordovsk. un-t, vyp. 36, 1964, 41-52

TOPIC TAGS: tungsten filament, tungsten filament lamp

TRANSLATION: A method of thermokinetic curves was used for determining the softening temperature and initial primary-recrystallization temperature. Ten lots of VA-3 tungsten produced by different manufacturers were tested. The annealing was carried out, at 10^{-4} torr, by direct passage of alternating current (for 10 min, 20 sec, 10 sec) and by rewinding in a hydrogen furnace, in dry and humid hydrogen, at a rate of 2 m/min in a 600-mm muffle. The temperature was measured by optical pyrometer. After the annealing, the specimens were ruptured at room temperature in air on an RM-3 tensile-testing machine; the error was ± 1% or lower. The

Card 1/2 UDC: 621.52:669

L 10819-66
ACC NR: AR5023518

thermal curves of tungsten-wire softening under the above conditions permitted determining the initial softening and recrystallization temperatures and permitted selecting proper conditions for thermal treatment of double helices. The methods of microhardness and electric-resistance measurements can be used for investigating stress relief in double helices. Bib 7.

SUB CODE: 09

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L 10632-66 EWT(m)/EWP(w)/T/EWP(t)/EWP(b)/EWA(c) IJP(c) JD/JG
ACC NR: AR5023519 SOURCE CODE: UR/0275/65/000/008/A013/A013

SOURCE: Ref. zh. Elektronika i yeye primeneniye, Abs. 8A85

AUTHOR: Aleksandrov, L. N.; Mironov, B. N.; Zvereva, T. M.

62
B

TITLE: Investigation of tungsten recrystallization upon quick electric heating

CITED SOURCE: Uch. zap. Mordovsk. un-t, vyp. 36, 1964, 53-57

TOPIC TAGS: tungsten filament, tungsten, metal recrystallization, tensile strength, annealing

TRANSLATION: Prior to annealing, the specimens were cleaned by boiling in a 20% solution of NaOH for 10 min. The recrystallization process was studied by the variation of the ultimate strength at room temperature with the annealing temperature and time. The ultimate strength was determined on a RM-05 tensile testing machine. For an annealing time of 30 min, the final primary-recrystallization temperature was about 1450C; for 10 min, almost 1520C; and for 200 sec, 1600C. From the above data, a curve of primary-recrystallization-completion time vs. annealing temperature was plotted. A metallographic method corroborated the fact that the recrystallization goes quicker with higher rates of heating. Bib 4.

SUB CODE: 11, 20, 13

Card 1/1

UDC: 621.52:669

L 59199-65 EWA(c)/EWT(m)/EWP(b)/T/EWP(t) JD

ACCESSION NR: AR5017541 UR/0058/65/000/006/E026/E026

22
8

SOURCE: Ref. zh. Fizika, Abs. E210

AUTHORS: Aleksandrov, L. N.; Kogan, A. N.

TITLE: Stress field around a growing spherical center of a new phase in a solid solution, with allowance for plastic deformation

CITED SOURCE: Uch. zap. Mordovsk. un-t, vyp. 36, 1964, 32-40

TOPIC TAGS: solid solution, phase separation, phase growth center, plastic deformation, concentration stress

TRANSLATION: The concentration stresses occurring when a new phase is separated from a solid solution are considered, with account taken of the formation of a region of plastic deformation near the separation. For a spherical center the authors determine the concentration field under isothermal separation conditions by solving the diffusion equation. It is assumed that the concentration of the dissolved substance is constant in the new phase, that the equilibrium concentration for a given temperature is conserved on the surface of the center, that the mass balance equation is satisfied, and that the concentrations are continuous on the boundary between the plastic and elastic zones. The components of the stress ten-

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L 59199-65

ACCESSION NR: AR5017541

sor and the coefficient of time dependence of the growth rate of the centers are calculated, and a comparison is made of the calculated values of the velocity: 1) as obtained by solving the elasto-plastic problem, 2) with account taken of elastic stresses only, 3) without account of concentration stresses. For the case of the growth of a ferrite center in supercooled austenite, the growth rate is determined together with the values of the components of the stress tensor at different distances. It is shown that the fall-off of the stress in the plastic region slows down.

SUB CODE: SS ENCL: 00

Card 2/2

L 61010-65 EWT(m)/T/EWP(t)/EWP(b)/EWA(c) JD

ACCESSION NR: AR5017430 UR/0137/65/000/006/I006/I006

SOURCE: Ref. zh. Metallurgiya, Abs. 6I36

AUTHOR: Aleksandrov, L. N. 44,55

TITLE: The kinetic theory of phase transitions in solid bodies

CITED SOURCE: Uch. zap. Mordovsk. un-t, vyp. 36, 1964, 3-31

TOPIC TAGS: metal phase system, crystal structure, recrystallization, austenite transformation

TRANSLATION: The article is a review of the author's works on the kinetics of phase transitions in one, two, and three component systems (using the example of the recrystallization of high melting metals and the decomposition of austenite in carbon and alloy steels). It considers the changes in the limiting mechanism of the transition in the solid phase with alloying and lowering of the temperature, the role of the atom drift in a field of force in diffusion processes, and effect of the participation of vacancies, dislocations, and foreign atoms in recrystallization

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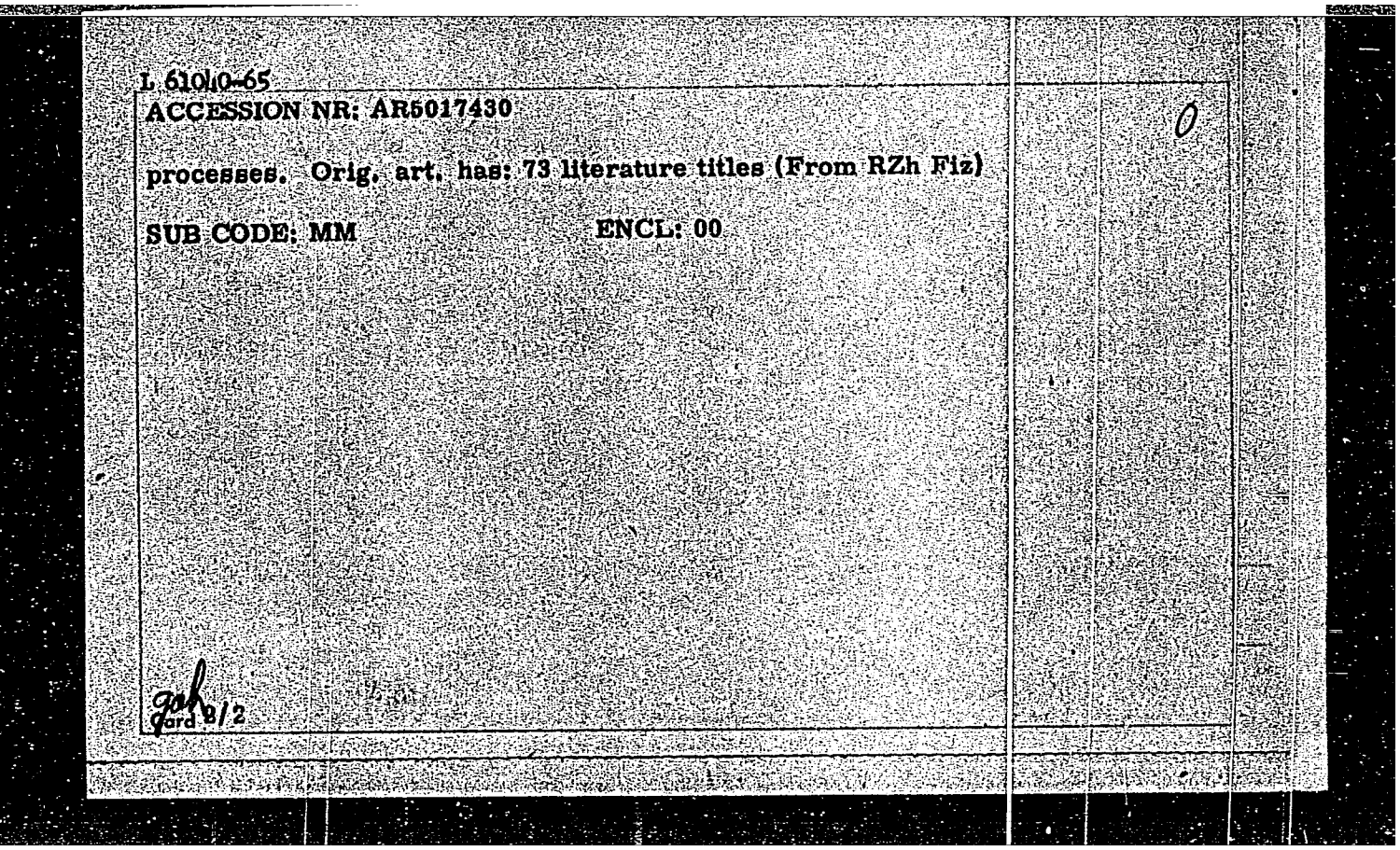

L 61010-65
ACCESSION NR: AR5017430

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processes. Orig. art. has: 73 literature titles (From RZh Fiz)

SUB CODE: MM ENCL: 00

gah
Card 2/2

ALEKSANDROV, L.N.; SHCHELKONOGOV, V.Ya.

Investigating the diffusion of carbon in tungsten and molybdenum at low carbon concentrations. Poroshk.met. 4 no.4:28-32 Jl-Ag '64. (MIRA 18:8)

1. Mordovskiy gosudarstvennyy universitet.

L 5365-66 EWT(d)/EWT(m)/EWP(w)/EPF(n)-2/T/EWP(t)/EWP(k)/EWP(b)/EWA(c) IJP(c)
ACC NR: AP5027385 JD/JG/EM SOURCE CODE: UR/0181/65/007/011/3153/3158

AUTHOR: Aleksandrov, L. N.; Mordyuk, V. S.; Savina, L. F. 92 B

ORG: All-Union Scientific Research Institute of Light Sources, Saransk (Vsezoyuznyy nauchno-issledovatel'skiy institut istochnikov sveta); Mordvinian State University (Mordovskiy gosudarstvennyy universitet)

TITLE: Low frequency internal friction of solids in a state of plastic deformation

SOURCE: Fizika tverdogo tela, v. 7, no. 11, 1965, 3153-3158

TOPIC TAGS: plastic deformation, tungsten, niobium, crystal lattice dislocation, internal friction

ABSTRACT: Internal friction is experimentally studied in polycrystalline tungsten and single crystals of tungsten and niobium. It is found that the theory of dislocation viscosity gives a satisfactory qualitative description of internal friction in deformed solids. However, the Swartz-Weertman theory requires some modification for describing internal friction in highly deformed metals to account for the change in the dislocation pinning factor during deformation, the reduction in the maximum length of the L_N loop due to interlaced dislocations, and the increase

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ACC NR: AP5027385

in its length with the separation of nodes in the dislocation net. The internal friction is a non-monotonic function of deformation in the metal, leveling off in a certain interval due to dislocation pinning, and then increasing again after separation of the pinned dislocations. Deformation of prehardened metal (to a dislocation density of 10^{12} cm^{-2}) shows three stages of internal friction similar to the three stages of fatigue observed in metals in the case of cyclic or thermocyclic loading. These internal friction stages are due to the motion of dislocations and interaction between dislocations and other lattice defects. Orig. art. has: 4 figures, 5 formulas.

SUB CODE: SS/ SUBM DATE: 06Feb65/ ORIG REF: 008/ OTH REF: 002

Card 2/2

L 61042-65 EWT(m)/T/EWP(t)/EWP(b)/EWA(c) JD

ACCESSION NR: AR5017432 UR/0137/65/000/006/I014/I014 93 B

SOURCE: Ref. zh. Metallurgiya, Abs. 6I91

AUTHOR: Aleksandrov, L. N.; Kogan, A. N. 44,55

TITLE: The field of stresses around the melting spherical center of a new phase in solid solutions, taking plastic deformations into account

CITED SOURCE: Uch. zap. Mordovsk. un-t, vyp. 36, 1964, 32-40

TOPIC TAGS: phase transition, solid solution, plastic deformation, metal diffusion, stress distribution, steel

TRANSLATION: Concentration stresses appearing with the separating out of a new phase from a solid solution were examined, taking into account the formation of plastic deformations in the neighborhood of the region of separation. For a spherical center, the concentration field under isothermal separation conditions was determined by solution of the diffusion equation. Assumptions were: constant

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L 61042-65

ACCESSION NR: AR5017432

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concentration of the dissolved substance in the new phase, maintenance of equilibrium at the surface of the center at a given concentration temperature, fulfilment of the conditions of mass balance, continuity of fields of stress and concentration at the boundary of the plastic and elastic zones. An estimate was made of the position of the boundary with respect to the surface of the new phase. The components of the stress tensor and the time coefficient of the dependence of the growth rate of the centers were calculated, and were compared with the calculated values of the rate. For the case of a ferrite center in supercooled austenite the growth rate and the values of the components of the stress tensor at different distances were determined. The slowing down of the decrease of the stress in the plastic region was pointed out (From RZh Fiz.)

SUB CODE: MM ENCL: 00

Card 2/2

L 61041-65 EWT(m)/EPF(n)-2/EWG(m)/T/EWP(t)/EWP(b)/EWA(c) Ps-4/Pu-4

ACCESSION NR: AR5017431 IJP(c) JD/JG UR/0137/65/000/006/I011/I011

47
46
B

SOURCE: Ref. zh. Metallurgiya, Abs. 6I73

AUTHOR: Aleksandrov, L. N. 44,55

TITLE: Study of the kinetics of recovery and recrystallization in high melting metals with respect to change in the tensile strength under elongation and the microhardness 27,49,55

CITED SOURCE: Uch. zap. Mordovsk. un-t, vyp. 36, 1964, 67-78

TOPIC TAGS: tungsten, recrystallization, hardness, tensile strength, internal friction

TRANSLATION: A review of methods for studying recrystallization in a sample of tungsten wire. Attention is paid to the possibility of using the temperature and the time dependences of $sigma_b$ or the microhardness for estimation of the start of weakening as a result of recrystallization during heating. Measurement of these dependences makes it possible to determine the stage of primary recrystalli-

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ACCESSION NR: AR5017431

zation earlier than by using the microstructural method or by measurements of electrical resistance. The temperature dependence of internal friction exhibits relaxation maxima connected with primary and cumulative recrystallization. Orig. art. has: 20 literature titles. V. Novikov

SUB CODE: MM ENCL: 00

Card 2/2

L 42048-66 EWT(l)/EWT(m)/T/EWP(t)/ETI LJP(c) JD/AW/JG/GG

ACC NR: AR6009970 SOURCE CODE: UR/0137/65/000/012/I079/I079

AUTHOR: Aleksandrov, L. N.

58
B

TITLE: Using certain methods of solid-state physics in research into materials for light sources

SOURCE: Ref. zh. Metallurgiya, Abs. 12I594

REF SOURCE: Nauchno-tekhn. sb. Vses. n.-i. in-t istochnikov sveta, vyp. I, 1965, 47-68

TOPIC TAGS: solid state physics, light source, metal grain structure, crystal defect, CRYSTAL DISLOCATION

ABSTRACT: The authors describe the results of the utilization of methods of solid-state physics in the investigations of light-source materials: W, Mo, and phosphate crystals. Grain growth in W and Mo is influenced by crystal lattice defects. Measurements confirm the gradual dissipation of dislocations with increasing temperature and time of annealing. Dislocation density N_d in W and Mo on recrystallization decreases from 10^{11} to 10^7 cm^{-1} but still remains quite considerable. The increased concentration of impurities in the neighborhood of dislocations provides the necessary conditions for the influence of an insignificant number of impurity atoms on grain growth during recrystallization. Dislocations in recrystallized specimens may

Card 1/2 UDC: 669.01:620.182/.186

42048-66
ACC NR: AR6009970

also be determined with the aid of the selective etching method. Measurements of electric conductivity of W and Mo following annealing make it possible to estimate the intensity of the diffusion fluxes of alloy-element atoms on the grain boundaries during grain growth. The degree of the high-temperature strength of a material depends on the diffusion mobility of lattice defects in the stress field. The use of methods of microstructural analysis and electron microscopy makes it possible to detect the presence of surface defects in the investigated specimens. It is pointed out that investigations of this kind have made it possible to improve the quality of the currently manufactured light sources. Bibliography of 47 titles. V. Sinev. [Translation of abstract]

SUB CODE: 20, 13, 11

Card 2/2 af

L 04066-67 EWT(1)/T/ IJP(c) GG

ACC NR: AR6023281 SOURCE CODE: UR/0058/66/000/003/E034/E034

AUTHOR: Aleksandrov, L. N.

TITLE: Kinetics of formation of the solid phase in two-component systems

35
34
B

SOURCE: Ref zh. Fizika, Abs. 3E262

REF SOURCE: Sb. Simpozium. Protsessy sinteza i rosta kristallov i plenok poluprovodnik. materialov, 1965. Tezisy dokl, Novosibirsk, 1965, 1

TOPIC TAGS: solid state, phase transition, sublimation, physical diffusion, crystal growth, epitaxial growing

ABSTRACT: The formation of the solid phase upon crystallization, sublimation, polymorphic transformation, or recrystallization can be described by the mechanism of creation and subsequent growth of centers. The produced volume is determined by the character of the dependence of the rate of creation and growth rate of the centers of the new phase on the time and on the transformation temperature, with account of the nonstationary nature of the process and form of the crystals. Transformations in two component systems are connected with redistribution of the atoms of the dissolved component by diffusion or their drift in the field of the stresses produced in the new phase. Therefore the formation of the crystal lattice of the new phase may not be the limiting link of the growth process. The kinetics of formation of the new phase under isothermal conditions is described by the kinetic equation of the transformation process, a solution of which yields for polycrystalline structure the distribution of the

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ACC NR: AR6023281

crystals by size. The kinetics of formation of single crystals and single-crystal films upon recrystallization under isothermal conditions, or upon rapid heating, is described. The singularities of the growth kinetics of single crystals and epitaxial growing are discussed. [Translation of abstract]

SUB CODE: 20

kh

Card 2/2

ACC NR: AR6035425 SOURCE CODE: UR/0137/66/000/009/I011/I012

AUTHOR: Aleksandrova, Yu. M.; Aleksandrov, L. N.

TITLE: Surface phenomena in the recrystallization of metals

SOURCE: Ref. zh. Metallurgiya, Abs. 9I76

REF SOURCE: Sb. Poverkhnostn. yavleniya v rasplavakh i voznikayushchikh iz nikh tverd. fazakh. Nal'chik, 1965, 100-107

TOPIC TAGS: metal surface, metal recrystallization, surface property, activation energy, metal grain, rupture strength, hardness

ABSTRACT: A study of recrystallization processes yields the necessary data for the calculation of the surface energy. In the case of primary recrystallization, the following relations are used:

$$W = \frac{16}{3}\pi\sigma^3/(\Delta F_0)^2;$$

and

$$\Delta F_0 = \frac{1}{2}E(\varepsilon - \varepsilon_0)^2$$

$$u_{eff} = u + \frac{1}{k}W,$$

where W - work of formation of a center with critical dimensions, ΔF_0 - change in the free energy of the plastically deformed metal during recrystallization, E - modulus of

Card 1/2

UDC: 669.017: 548.53

ACC NR: AR6035425

elasticity, ϵ - degree of deformation, ϵ_0 - quantity characterizing the change in the form, u_{eff} - effective recrystallization activation energy, and k - kinetic coefficient. Calculation for tungsten yields $\sigma = 112$ erg/cm^2 ($\Delta F_0 = 80$ cal/cm^3, $\epsilon - \epsilon_0 = 10\%$, $k = 1$), and $\sigma = 240$ erg/cm^2 for $k = 4$; for molybdenum $\sigma = 104$ erg/cm^2. If the force moving the grain boundaries is σ, as is in the case of condensation recrystallization, then it is calculated from the relation $K\sigma v/r = \Delta F$, where K is a constant equal to 1 - 3, r is the block dimension, and v is the specific volume. Calculation yields for tungsten $\sigma = 480$ erg/cm^2 ($r = 5 \times 10^{-4}$ cm, $K = 2$, temperature 2300K), and for molybdenum $\sigma = 160$ erg/cm^2 (temperature 2000K, $r = 2 \times 10^{-4}$ cm). Calculations also show that σ in condensation recrystallization can be calculated more accurately than in primary crystallization. The estimates given above did not take into account the influence of the medium surrounding the metal during the crystallization annealing. A study of the rupture strength and of the microhardness of tungsten brand BA-3 after annealing for ten minutes in H_2 in a vacuum of 10^{-3} mm Hg, and Kr at 0.5 and 1 atmospheres has shown that the start of the condensation recrystallization in Kr is delayed by almost 200C compared with vacuum. In H_2 one observes acceleration of the strength loss processes. The active influence of the gas medium, including inert gases, on the kinetics of the recrystallization is connected with the influence of the gases on the surface properties of the grain boundaries. G. Rymashevskiy [Translation of abstract]

SUB CODE: 11

Card 2/2

L 04185-67 EWT(m)/EWP(w)/T/EWP(t)/ETI IJP(c) JD/JC/GD

ACC NR: AT6026911 SOURCE CODE: UR/0000/66/000/000/0059/0076

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TITLE: A study of high temperature strength and thermal fatigue resistance of refractory metals by internal friction methods

SOURCE: AN SSSR. Institut metallurgii. Vnutrenneye treniye v metallakh i splavakh (Internal friction in metals and alloys). Moscow, Izd-vo Nauka, 1966, 69-76

TOPIC TAGS: internal friction, high temperature metal, high temperature strength, tungsten, thermal fatigue, recrystallization range, grain size, metallographic examination, plastic deformation

ABSTRACT: The temperature dependence of internal friction in the 800-2500°C range was studied in zone refined polycrystalline and monocrystalline tungsten. Three peaks are normally observed in deformed industrial-grade tungsten: a 1250°C peak caused by polygonization, a 1700°C recrystallization peak, and a 2000°C grain boundary relaxation peak. In zone refined tungsten only a 1500°C grain boundary peak which decreased after recrystallization was observed. A slight bump occured in the zone refined single crystals at 1500°C. This bump increased in height after thermal cycling and it was concluded that the single crystal bump was caused by cooling after zone melting. The re-

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